PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (**http://bmjopen.bmj.com/site/about/resources/checklist.pdf**) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

ARTICLE DETAILS

TITLE (PROVISIONAL)	Impact of Ebola outbreak on reproductive health services in a rural district of Sierra Leone. A prospective observational study.
AUTHORS	Quaglio , GianLuca; Tognon, Francesca; Finos, Livio; Bome, David; Sesay, Santigie; Atiba, Kebbie; Di Gennaro, Francesco; Bienvenu Salim, Camara; Marotta, Claudia; Pisani, Vincenzo; Bangura, Zainab; Pizzol, Damiano; Saracino, Annalisa; MAZZUCCO, WALTER; Jones, Susan; Putoto, G

VERSION 1 - REVIEW

REVIEWER	Kate Kerber University of Alberta, Canada
REVIEW RETURNED	02-Feb-2019

GENERAL COMMENTS	Thank you for the opportunity to review the manuscript entitled, “Impact of Ebola outbreak on reproductive health services: implementing an ambulance referral system in a rural district of Sierra Leone.” Understanding the different impacts of ebola on health system strength is an important goal. Documenting attempts to strengthen referral systems is another important goal. However, this paper struggles to connect the two aspects, and is hard to follow and interpret at times. Overall comments The paper seems to be written with the aim of demonstrating the impact of the referral system, not an assessment of health system utilization pre/during/post ebola. The main thrust of the manuscript ends up describing and promote a specific health system strengthening project, led by an NGO. It appears that members of that NGO were involved in the data collection, evaluation and authorship of the paper. That could be a potential conflict of interest. If there was independence in the implementation and/or data collection and evaluation, this should be made clear. It is a huge leap to conclude that services were maintained during and after ebola “due to the strengthened referral service.” There are a number of potential explanations for the lack of change in service delivery levels, most plausibly because the district was not directly affected by ebola in the same way as other districts in the country. The findings could be presented much more objectively, and with separate aims, either focusing on the details of the referral system itself, or a more in-depth analysis of the routine prospective facility data and speculating on the (many!) reasons for the lack of change over the pre/during/post ebola time periods.

	Specific comments: Abstract: Methods: there's no description of where the data come from (e.g. routine or project sources or independent). In the list of main outcome measures, there's nothing to indicate the link to the referral system which is a much bigger component of the study than the main outcome measures describe. Results: The time periods of ebola / pre-ebola / post-ebola are really difficult to follow in the abstract. Naming these as different phases (eg 1, 2, 3) or some other mnemonic would be helpful When time periods are compared (in abstract and throughout the paper), it's not clear which direction the results refer to, and they are presented in a confusing non-chronological manner. e.g. "data between the ebola period and the pre-ebola period shows a statistically significant increase." What are the data between the period? Can this be stated much more simply? Conclusion: The conclusion implies causality but the study was not designed to measure this. Strengths and limitations These do not sell the study at all (e.g. data collected allowed trend comparison? That is fairly standard) Introduction Page 5, Line 38-49 – the number of EVD cases seems key. Later in the paper it is noted that Pujehun had 49 confirmed cases. Combining it with Bonthe could be misread to be 100 in each district. But regardless, the number is MUCH less than other districts. The speculation that the fear of ebola may have prevented people from accessing services is true, but the small number of cases amongst people actually known by community members may have also increased confidence, leading to the maintenance of utilization rates after the initial drop. Page 6, Line 13 – The referral system activities started in January 2015. Was this intentionally timed to correspond to the end of ebola? Page 6, line 21 – It's not clear what "wide reporting" was done with the previous study. Widely reported where and to whom? Page 6, line 40 – The aims suggest that the aims are to analyse the data trends. But the paper as written suggests that the aim of the study is to describe and determine the impact of the referral system. The data are used to support conclusions regarding the referral system. Methods Setting – a map figure would be helpful to situate Pujehun and other districts in the country. Referral system – this description seems out of place given that none of the outcome indicators are directly related to the referral system. Would be more appropriate in a box, and even more so in a different paper specifically pertaining to the referral system. Line 55 – who did the healthcare workers receive regular feedback from? The study team? The NGO? Government providers? Study design – the justification for elongating time period of ebola is not satisfying. Use the dates of first case and ebola-free declaration and then run a sensitivity analysis to see if anything changes, instead of applying assumptions a priori.

	Data collection – routine data collection and HMIS is not always very reliable. Were there any data quality measures put in place? Were data collection staff trained on specific definitions, especially major direct obstetric complications? What measures were undertaken to define and collect information on all maternal deaths (e.g. were these sourced just from the antenatal and maternity wards, or all parts of the hospital)? Were stillbirths and neonatal deaths included in numbers of paediatric deaths? Results Consider summarizing all the results in a first paragraph, or providing an overall district-wide summary rather than by level. The pre / during / post comparison isn't easy to understand and changing the terminology used for the different time periods. The use of "community" as a level, referring to community health facilities, could be confusing. These are still part of the health system. Did the referral system (e.g. ambulances, motorbikes) take patients to the clinics? The hospital is still a part of the community, and the community health facilities, are still facilities. Could the decrease in use of the community health facilities explain the increase in use of hospital services? Referral system – it is difficult to interpret the significance of an absolute number of referrals. Discussion Line 19 - "because the post ebola reinforcement of the RS led to an increase in pediatric admissions" – as noted, there are other explanations for the increase in pediatric admissions. Line 28 (and throughout) - The facility / community language is confusing given that all the data come from facilities. Line 34-37 – This statement again casts doubt on the objectiveness of the authors. The causal link between the work of one NGO and the reduced impact of EVD may be true but even extensive descriptions can't prove this. Line 39 – "frequently associated with" – by whom? Vertical interventions are sometimes necessary, especially in the context of an acute crisis. If vertical service delivery (e.g. treatment centres set up by international organizations), were associated with failures in management procedures as described, these should be cited. Vertical interventions are rarely appropriate in a routine health system that is functioning at basic levels. Given that Pujehun district was not as impacted by an overwhelming number of ebola cases, it would have been hard to justify a vertical approach. The focus on health system strengthening in this district should be a basic expectation of service delivery, not a unique aspect of the program. The authors should consider that there are a number of other, more essential limitations of this analysis in addition to those listed. A much more self-critical lens would be appreciated.

REVIEWER	Adrienne E. Strong University of Florida, United States
REVIEW RETURNED	12-Feb-2019

GENERAL COMMENTS	This is a very interesting article with some important contributions to our thinking on the Ebola crisis. I would, however, recommend moving some information from the discussion section much earlier in the paper. Specifically, the information starting at the beginning of the "Pre Ebola and Ebola period" line 34 on page 17 through page 18 line 16. This is vitally important context that would help the reader to interpret the statistics and therefore, in my opinion, might better serve the reader if it was earlier in the manuscript. I also feel there could be additional analysis or explanation of the low number of cases in the district and the effect this had on the other findings. It seems a bit difficult to extricate the significance of this fact from the impact of the RS intervention. As a minor point, it would be helpful to ensure that the article can be useful to a broad readership, if the authors could define their use of things like ANC 1 and ANC 4. I am fairly certain I understand the current usage but I feel the manuscript's clarity would be improved if this was defined once in the beginning. Page 19, line 37-38 about family planning seems to be a non sequitur and does not connect to anything before or after. Consider moving or deleting this. Or just make it the start of a new paragraph? I see after a couple of sentences this topic of family planning comes up again. I would suggest making it a new paragraph at line 37 and clarifying this discussion of family planning because it currently seems unrelated to anything else. Likewise, in the results, the authors should consider a bit more emphasis on family planning. As it is, I had to go back to reread the community level sections because I did not recall reading anything about family planning measures. Overall, I recommend this for publication with the above-mentioned minor revisions. It is an interesting study that adds another perspective to the events of this epidemic.

REVIEWER	Julie Morris University of Manchester UK
REVIEW RETURNED	04-Mar-2019

GENERAL COMMENTS	This largely descriptive study derives information on maternal and child health service usage over a six-year period for a district in Sierra Leone. Results are presented for three time periods, pre-Ebola, Ebola, and post-Ebola, and comparisons between periods are made. The data appear to have been obtained and analysed appropriately. However, there are a few points which need to be addressed.

	1. A detailed description of the statistical model used to analyse the data is currently included in the text. I suggest that this would be better placed in an Appendix. 2. Over a hundred statistical comparison tests are carried out (see Tables 1, 2 and 3). These increase the likelihood of obtaining chance statistical findings, and also make it difficult to determine the results of most interest. What are the primary comparisons? It would seem more appropriate to limit the number of formal statistical comparisons and concentrate on the more important findings. Figures 1, 2 and 3 are a good illustration of the data. However, Tables 1, 2 and 3 present too much information. 3. The information presented in the Results section reads as a simple listing of the data given in the tables. It is not necessary to duplicate all the information.

VERSION 1 – AUTHOR RESPONSE

REVIEWER: 1

Abstract

Methods: there is no description of where the data come from (e.g. routine or project sources or independent). In the list of main outcome measures, there's nothing to indicate the link to the referral system which is a much bigger component of the study than the main outcome measures describe.

Results: The time periods of Ebola / pre-Ebola / post-Ebola are really difficult to follow in the abstract. Naming these as different phases (eg 1, 2, 3) or some other mnemonic would be helpful. -When time periods are compared (in abstract and throughout the paper), it's not clear which direction the results refer to, and they are presented in a confusing non-chronological manner. e.g. "data between the Ebola period and the pre-Ebola period shows a statistically significant increase." What are the data between the period? Can this be stated much more simply?

Conclusion: The conclusion implies causality but the study was not designed to measure this.

On the basis of these remarks, the abstract has been completely revised as follow:

'Objectives To assess the trends concerning utilisation of maternal and child health (MCH) services before, during, and after the Ebola outbreak, quantifying the contribution of a reorganised referral system (RS).

Design A prospective observational study of MCH services.

Setting Pujehun district in Sierra Leone, 77 community health facilities and 1 hospital from 2012 to 2017.

Main outcome measures MCH utililization was evaluated by assessing: i) institutional deliveries, Cesarean-sections, paediatric and maternity admissions and deaths, and major direct obstetric complications (MDOCs), at hospital level; ii) antenatal care (ANC) 1 and 4, institutional delivery, and family planning, at community level. Contribution of a strengthened RS was also measured.

Results At hospital level, there is a significant difference between trends Ebola vs pre-Ebola for maternal admissions (7, 95% CI 4 to 11, p <0.001), MDOCs (4, 95% CI 1 to 7, p = 0.006), and institutional deliveries (4, 95% CI 2 to 6, p = 0.001). There is also a negative trend in the transition

from Ebola to post Ebola for maternal admissions (-7, 95% CI -10 to -4, p <0.001), MDOCs (-4, 95% CI -7 to -1, p 0.009) and institutional deliveries (-3, 95% CI -5 to -1, p 0.001). The differences between trends pre-Ebola vs post-Ebola are only significant for pediatric admissions (3, 95% CI 0 to 5, p 0.035). At community level, the difference between trends Ebola vs pre-Ebola and Ebola vs post-Ebola are not significant for any indicators. The differences between trends pre-Ebola vs post-Ebola show a negative difference for institutional deliveries (-7, 95% CI -10 to -4, p <0.001) ANC 1 (-6, 95% CI -10 to -3, p <0.001), ANC 4 (-8, 95% CI -11 to -5, p <0.001) and family planning (-85, 95% CI -119 to -51, p <0.001).

Conclusions A stronger health system compared to other districts in Sierra Leone and a strengthened RS enabled health facilities in Pujehun to maintain service provision and uptake during and after the Ebola epidemic.'

Strengths and limitations

These do not sell the study at all (e.g. data collected allowed trend comparison? That is fairly standard)

Please see the previous page, the reply to the point#3 of Editorial remarks to author.

Introduction

Page 5, Line 38-49 – the number of EVD cases seems key. Later in the paper it is noted that Pujehun had 49 confirmed cases. Combining it with Bonthe could be misread to be 100 in each district. But regardless, the number is MUCH less than other districts. The speculation that the fear of Ebola may have prevented people from accessing services is true, but the small number of cases amongst people actually known by community members may have also increased confidence, leading to the maintenance of utilization rates after the initial drop.

Thank you for this remark, which has been addressed in the Conclusions section (page 16) as follows: The Pujehun district had 49 confirmed EVD cases. This number is much lower than in other districts. If it is true that the fear of Ebola may have prevented people from accessing health services, the small number of EVD cases in the community may have also raised confidence, leading to the increase of utilization rates after the initial drop.

Page 6, Line 13 – The referral system activities started in January 2015. Was this intentionally timed to correspond to the end of Ebola?

The beginning of the referral system coincides with the end of the epidemic for the simple reason that some of the ambulances used for the Ebola crisis were reassigned for the normal transport of patients.

Page 6, line 21 – It's not clear what "wide reporting" was done with the previous study. Widely reported where and to whom?

'Wide reporting' refers to reference 18 (Quaglio GL, Pizzol D, Bome D, et al. Maintaining maternal and child health services during the Ebola outbreak: experience from Pujehun, Sierra Leone. PLoS Currents 2016;8), mentioned immediately before. However, this part of the manuscript was also revised in the light of Referee #2, point 1, which suggested to better explain the content of our previous work. Consequently a part of the Discussion has been included now in the Introduction (please see also our response to Referee #2, point 1).

Page 6, line 40 – The aims suggest that the aims are to analyse the data trends. But the paper as written suggests that the aim of the study is to describe and determine the impact of the referral system. The data are used to support conclusions regarding the referral system.

The sentence has been reformulated as follows (page 6): ‘With this background, the aims of this study are: i) to assess trends in institutional deliveries, C-sections,.....; ii) to assess trends in ANC 1 and 4, institutional delivery,.....’

Methods

Setting – a map figure would be helpful to situate Pujehun and other districts in the country.

As suggested, a map - now Figure 1 - has been added.

Referral system – this description seems out of place given that none of the outcome indicators are directly related to the referral system. Would be more appropriate in a box, and even more so in a different paper specifically pertaining to the referral system.

The referral system helps to give a correct interpretation of the results of the post-Ebola phase and we believe it would be incorrect to remove this information.

Line 55 – who did the healthcare workers receive regular feedback from? The study team? The NGO? Government providers?

The sentence ‘All healthcare workers involved in the emergency transfer system received regular feedback on the appropriateness of each referral carried out’, is perhaps redundant and not necessarily useful; It has been removed.

Study design – the justification for elongating time period of Ebola is not satisfying. Use the dates of first case and Ebola-free declaration and then run a sensitivity analysis to see if anything changes, instead of applying assumptions a priori.

We considered the Ebola period from one month before the first confirmed case in the district (i.e. June 2014), to three months after the last confirmed case in the district (i.e. February 2015). We have added now in the text (page 7), a sentence which clarifies that the Ebola period we have considered ends one month after the country has been declared Ebola free.

The enlargement of the Ebola period in comparison to that suggested by the reviewer - the dates of first case and Ebola-free declaration - was done because in Sierra Leone the outbreak had started in other districts of the country before the first case registered in Pujehun and continued to affect the country until November 2015. Finally, it should be noted that also other previous studies which tried to compare MCH trends between different periods (pre, Ebola and post Ebola periods) have taken longer times than the dates of first case and Ebola-free declaration. We have applied the same approach.

Data collection – routine data collection and HMIS is not always very reliable. Were there any data quality measures put in place? Were data collection staff trained on specific definitions, especially major direct obstetric complications?

In response to this question, the following sentence has been added in Methods (page 7); Health personnel at hospital and PHUs levels were trained on Life Saving Skills – Emergency Obstetric and Newborn Care, including referral criteria and definition of MDOCs.29

In addition, the following sentence has been added in page 8: Quarterly review meetings were organized with the staff in charge of the health facilities to address data discrepancies in the reports. Technical assistance was provided to the DHMT to improve timeliness, completeness, and accuracy of data regarding CEmOC and BEmONC services.

What measures were undertaken to define and collect information on all maternal deaths (e.g. were these sourced just from the antenatal and maternity wards, or all parts of the hospital)? Were stillbirths and neonatal deaths included in numbers of paediatric deaths?

The following sentence has been added in Methods - Data collection (page 8); MDOC cases were collected using a dedicated database within the hospital and confirmed by a gynaecologist. All hospital maternal deaths were reviewed by DHMT and classified according to Maternal Death Surveillance and Response policy by MoHS. Paediatric deaths did not include stillbirths and early neonatal deaths, but only deaths of children admitted to the paediatric ward.

Results

Consider summarizing all the results in a first paragraph, or providing an overall district-wide summary rather than by level. The pre / during / post comparison is not easy to understand and changing the terminology used for the different time periods.

All results are concisely presented in the first paragraph of the Discussion section, which provides an overall district-wide summary. We believe that changing the terms for the different periods of the Ebola outbreak would not aid with clarity, and have largely kept them as they are.

The use of “community” as a level, referring to community health facilities, could be confusing. These are still part of the health system. Did the referral system (e.g. ambulances, motorbikes) take patients to the clinics? The hospital is still a part of the community, and the community health facilities, are still facilities.

We thank the Referee for this remark: in page 4, line 119-21, we have clarify the issue as follow: In this paper, community level refers to Peripheral Health Units (PHUs), i.e. all health facilities outside the hospital.

Referral system – it is difficult to interpret the significance of an absolute number of referrals.

The manuscript reports more than the absolute numbers on the referral system. In the results section (page.....) it is mentioned that between January 2015 and December 2017 there were 2,450 obstetric referrals. Of these, 1,574 (64%) were MDOC, which represent 70% of all the 2,233 MDOCs treated in the hospital over the same period. It is also stated that at the same time 4,671 paediatric patients were admitted to the hospital through the referral system, representing 72% of the 6,518 total admission during the same period.

Discussion

Line 19 - “because the post Ebola reinforcement of the RS led to an increase in pediatric admissions” – as noted, there are other explanations for the increase in pediatric admissions.

As mentioned in the study, in the post-Ebola period, all indicators (except for maternal deaths) showed an increase in comparison with the pre-Ebola period. This was particularly marked at hospital level because the post Ebola reinforcement of the referral system led to an increase in pediatric admissions, maternal admissions, and consequently a rise of institutional deliveries, C-sections, and MDOCs.

Line 28 (and throughout) - The facility / community language is confusing given that all the data come from facilities.

‘At facility and community levels’ has been removed. With the above clarification on the definition of community level, we believe that now the text is more comprehensible.

Line 34-37 – This statement again casts doubt on the objectiveness of the authors. The causal link between the work of one NGO and the reduced impact of EVD may be true but even extensive descriptions can't prove this.

Line 34-37 of the original version of the manuscript refers to our previous work published on PLOS (reference n. 18). That work has its limits but it certainly represents an interesting experience in a country heavily affected by Ebola. The publication was selected, with a few others, for a recent meta-analysis, which analysed the utilization of non-Ebola health care services during Ebola outbreaks (Wilhelm JA, Helleringer S. Utilization of non-Ebola health care services during Ebola outbreaks: a systematic review and meta-analysis. J Glob Health. 2019;9(1):010406. doi: 10.7189/jogh.09.010406.

Line 39 – "frequently associated with" – by whom? Vertical interventions are sometimes necessary, especially in the context of an acute crisis. If vertical service delivery (e.g. treatment centres set up by international organizations), were associated with failures in management procedures as described, these should be cited. Vertical interventions are rarely appropriate in a routine health system that is functioning at basic levels. Given that Pujehun district was not as impacted by an overwhelming number of Ebola cases, it would have been hard to justify a vertical approach. The focus on health system strengthening in this district should be a basic expectation of service delivery, not a unique aspect of the program.

Former line 39 is now part of the Introduction, page 4-5. Following the reviewer's suggestion, the phrase has been modified as follow: As described in our previous reports,17 18 a number of measures were put in place to control the Ebola epidemic in the Pujehun district which reduced the impact of the disease on mothers and children compared to other districts. During this EVD epidemic, the predominantly vertical focus on outbreak control was associated with failures in providing effective care for routine health needs.19-21 In contrast, the approach implemented in the Pujehun district was not based on vertical actions and 'humanitarian response to health emergencies with a short half-life'.21 Rather, it worked on strengthening all the components of the health system - governance, human resources, communiy involvement - before, during and, after the epidemic.

The authors should consider that there are a number of other, more essential limitations of this analysis in addition to those listed. A much more self-critical lens would be appreciated.

As mentioned in our reply to the Referee#1 - Discussion, point 1 -, an additional limitation has been included in the Conclusions section.

REVIEWER: 2

This is a very interesting article with some important contributions to our thinking on the Ebola crisis. I would, however, recommend moving some information from the discussion section much earlier in the paper. Specifically, the information starting at the beginning of the "Pre Ebola and Ebola period" line 34 on page 17 through page 18 line 16. This is vitally important context that would help the reader to interpret the statistics and therefore, in my opinion, might better serve the reader if it was earlier in the manuscript.

We agree and thank the Referee for this remark: the information starting at the beginning of the "Pre Ebola and Ebola period" (line 34 on page 17 through page 18 line 16 of the original version of the

study) has now been moved to the Introduction section (from page 4 line 121, to page 5, line 145). The numbering of the references has consequently been revised.

I also feel there could be additional analysis or explanation of the low number of cases in the district and the effect this had on the other findings. It seems a bit difficult to extricate the significance of this fact from the impact of the RS intervention.

The following sentences have been added in page Discussion section, page 14: Possible explanations for this may include: bypassing, i.e. using alternative health care instead of free or subsidized public clinics; increased opportunities to get transport to seek healthcare in neighbouring districts; reduced demand for MCH services at community level; and reduced quality of MCH services at PHUs.

As a minor point, it would be helpful to ensure that the article can be useful to a broad readership, if the authors could define their use of things like ANC 1 and ANC 4. I am fairly certain I understand the current usage but I feel the manuscript's clarity would be improved if this was defined once in the beginning.

We are certainly ready to insert a definition of ANC 1 and 4; however, we believe that for reasons of space (the text is already long), and due to the fact that the journal target audience has health professionals with experience in the sector, this clarification can be omitted.

Page 19, line 37-38 about family planning seems to be a non sequitur and does not connect to anything before or after. Consider moving or deleting this. Or just make it the start of a new paragraph? I see after a couple of sentences this topic of family planning comes up again. I would suggest making it a new paragraph at line 37 and clarifying this discussion of family planning because it currently seems unrelated to anything else.

We thank you for this suggestion which helps with the readability of the text: a new paragraph has been created.

Likewise, in the results, the authors should consider a bit more emphasis on family planning. As it is, I had to go back to reread the community level sections because I did not recall reading anything about family planning measures.

In the Results section, the following change has been included (page 11): ‘However, there is a negative difference between trends among the two periods, for all the variables considered: institutional deliveries (-7, 95% CI -10 to -4, p <0.001) ANC 1 (-6, 95% CI -10 to -3, p <0.001), ANC 4 (-8, 95% CI -11 to -5, p <0.001) and most significantly for family planning (-85, 95% CI -119 to -51, p <0.001) (Figure 4).’

Overall, I recommend this for publication with the above-mentioned minor revisions. It is an interesting study that adds another perspective to the events of this epidemic.

REVIEWER: 3

This largely descriptive study derives information on maternal and child health service usage over a six-year period for a district in Sierra Leone. Results are presented for three time periods, pre-Ebola, Ebola, and post-Ebola, and comparisons between periods are made. The data appear to have been obtained and analysed appropriately. However, there are a few points which need to be addressed.

A detailed description of the statistical model used to analyse the data is currently included in the text. I suggest that this would be better placed in an Appendix.

Statistics is an important part of the present study: we believe it is appropriate to keep it as it is. However, we leave to the Editor the final decision whether to confine the description of the statistical model to the appendix. Our suggestion might be to put the original tables in the appendix, thus

providing all the data available. At the end of the 'Statistical analysis' section we added the following line (page 9): The full data analysis is available in Annex 1.

Over a hundred statistical comparison tests are carried out (see Tables 1, 2 and 3). These increase the likelihood of obtaining chance statistical findings, and also make it difficult to determine the results of most interest. What are the primary comparisons? It would seem more appropriate to limit the number of formal statistical comparisons and concentrate on the more important findings. Figures 1, 2 and 3 are a good illustration of the data. However, Tables 1, 2 and 3 present too much information.

The information presented in the Results section reads as a simple listing of the data given in the tables. It is not necessary to duplicate all the information.

Thank you for these observations (# 2 and 3) which allow us to simplify the presentation of the results. The three original tables have been summarized in a new table (Table 1), which shows only the results of the differences between averages of the three periods considered (pre Ebola, Ebola, and post Ebola). As suggested by the Referee, the results related to trends have been removed from the Table 1, but retained in the text, and are further elaborated by the figures (Figures 2-4).

VERSION 2 – REVIEW

REVIEWER	Julie Morris University of Manchester
REVIEW RETURNED	07-Apr-2019

GENERAL COMMENTS	The aim of the study has been clarified and the results displayed in the original tables have been re-organised and simplified to provide a much clearer presentation of the data. The new tables showing baseline characteristics etc give useful additional information. However, there are a few remaining points which could be addressed: 1. I do suggest that a general overview of the statistical model should be included in the main text, and a more detailed description placed in an Appendix. 2. Although the number of p-values included in the Tables and text has been reduced, several formal statistical comparison tests are still carried out (see Table 1 and the Results section). Perhaps an acknowledgement of the problem of multiple testing and the increased type I error could be included in the Discussion session?

REVIEWER	Kate Kerber University of Alberta, Canada
REVIEW RETURNED	10-Apr-2019

GENERAL COMMENTS	The authors have made strong edits and clarifications on this manuscript. The language around the pre / during / post ebola

	periods by each health system level, and terms like "negative difference between trends" continue to make the paper difficult to read but I respect the authors decision not to edit. The paper still contains problematic language claiming a causal link between the referral system and reduced spread of EVD. Please apply humility to the phrasing using words like "may have contributed to," "possibly led to" and other less causal terms, especially given that the investigators are not independent of the implementing organization, which presents a conflict and potential bias. Examples: Page 4: "a number of measures were put in place to control the Ebola epidemic in the Pujehun district which reduced the impact of the disease on mothers and children compared to other districts." page 13: "It worked on strengthening all the components of the health system - before, during, and long after the epidemic. This approach reduced the spread of infection and the impact of the disease on MCH services." page 17: In Pujehun the implementation of an RS immediately after the acute Ebola phase reduced delays in patients accessing care and enabled a significant improvement in all MCH indicators at hospital level.

VERSION 2 – AUTHOR RESPONSE

REVIEWER: 3

1.I do suggest that a general overview of the statistical model should be included in the main text, and a more detailed description placed in an Appendix.

As suggested, a general overview of the statistical model has been included in the main text (page 8), as follow:

For each indicator, a segmented seasonal autoregressive model of order 1 was estimated. The segments defined the three periods: before the EVD epidemic (January 2012 to May 2014), during the epidemic (June 2014 to February 2015), and after the epidemic (March 2015 to December 2017). Differences were considered statistically significant at . The analysis was performed using R.30 The full description of the methodology of the statistical analysis is available in Annex 1.

Consequently, a more detailed description of the statistical analysis is now placed in a new annex, the Annex 1.

2.Although the number of p-values included in the Tables and text has been reduced, several formal statistical comparison tests are still carried out (see Table 1 and the Results section). Perhaps an acknowledgement of the problem of multiple testing and the increased type I error could be included in the Discussion session?

The following sentence has been included in the Conclusions section, page 16:

All the results should be taken with some degree of statistical caution, since no correction was performed to take into account the multiplicity of the test carried out.

REVIEWER: 1

The paper still contains problematic language claiming a causal link between the referral system and reduced spread of EVD. Please apply humility to the phrasing using words like "may have contributed

to," "possibly led to" and other less causal terms, especially given that the investigators are not independent of the implementing organization, which presents a conflict and potential bias.

Examples:

Page 4: "a number of measures were put in place to control the Ebola epidemic in the Pujehun district which reduced the impact of the disease on mothers and children compared to other districts."

The sentence has been reformulated as follows:

‘a number of measures were put in place to control the Ebola epidemic in the Pujehun district which might have reduced the impact of the disease on mothers and children compared to other districts’.

page 13: "It worked on strengthening all the components of the health system - before, during, and long after the epidemic. This approach reduced the spread of infection and the impact of the disease on MCH services."

The sentence has been reformulated as follows:

‘It worked on strengthening all the components of the health system - before, during, and long after the epidemic. This approach may have contributed to reducing the spread of infection and the impact of the disease on MCH services.17 18

page 17: In Pujehun the implementation of an RS immediately after the acute Ebola phase reduced delays in patients accessing care and enabled a significant improvement in all MCH indicators at hospital level.

The sentence has been reformulated as follows:

‘In Pujehun the implementation of an RS immediately after the acute Ebola phase might have reduced delays in patients accessing care and enabled a significant improvement in all MCH indicators at hospital level.’